NSU NOVA SOUTHEASTERN UNIVERSITY Abraham S. Fischler School of Education

Innovate: Journal of Online Education

Volume 4
Issue 4 *April/May 2008*

Article 4

5-1-2008

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Video game use in education has focused on the application of games within the existing education system and on their inherent potential for producing learning (Gee 2003). However, research has revealed a fundamental mismatch between the goals of games and the object of school-based learning (Sandford et al. 2006; Squire 2005; Becta 2002). As a result, efforts to integrate games into the curriculum have frequently fallen flat despite the best intentions of teachers and the gaming industry. Such efforts have failed either because games designed to educate do not engage their intended audience, or because truly engaging games do not provide enough educational value.

In part, this failure has been because games are fundamentally incompatible with the school environment (Exhibit 1). From the student's point of view, integrating games into the school culture dilutes the experience of game playing. From the teacher's point of view, games are too long, too immersive, and focused on the wrong outcomes, motivating students to achieve defined win states rather than to seek knowledge. The problem is that educational game designers have approached the problem backward: Rather than striving to get games into education, educators should be investigating ways to get education into games.

This article suggests ways to accomplish this via a new genre of video game that engages gamers outside of formal schooling. This approach is contextualized by a brief outline of the shortcomings of video game usage within education. The article then illustrates how curriculum-related learning material can be integrated into commercial-quality video games.

Video Games in the Classroom

Video games used in learning fall into four categories, ranging from purpose-built edutainment to commercial games integrated as-is into the curriculum (Exhibit 2). Each of these has potential for learning, but as Papert (1998) notes in reference to educational games, "Shavian reversals—offspring that keep the bad features of each parent and lose the good ones—are visible in most software products that claim to come from a mating of education and entertainment" (88). Games that come into contact with the educational establishment often become "teacherized" by the need to embed, add, or refer to educational content linked to performance-related outcomes within the curriculum. Each of the four main categories has this element of teacherization within them, although the reversioned commercial game has the greatest possibility for producing a truly gamelike learning experience. One example of this is the *DoomEd* research and development project, which attempted to create such a game by integrating learning content into a modded video game (Exhibit 3). A new genre might emerge from this combination of commercial entertainment values and curriculum standards, but it is the location of games within the curricular system, as much as the design of the games themselves, that creates the teacherization phenomenon and produces gamelike learning rather than truly entertaining learning games. Any new genre of learning game will need to some extent to sit outside of the curriculum if gaming values are to be preserved.

The Killer Application

The development of a new genre of learning game that avoids the pitfalls of teacherization by incorporating learning seamlessly into an engaging, challenging game is problematic because it will require a change of

both approach and mindset to accommodate the sometimes conflicting values of educators and gamers. As a recent British Board of Film Classification (BBFC) research report notes:

Gamers claim that playing is educational; it familiarizes you with ways of being and doing that you would otherwise not know about. It is sometimes laughingly conceded (by gamers) that much of this learning has little relevance to ordinary life. (Cragg, Taylor, and Toombs 2006, “What's to like? The appeal of video games,” ¶10)

At the same time, educators insist that video games must be embedded in an educational structure to ensure that effective learning does happen:

But this does not mean that anything goes, or that educators should simply turn learners loose in interactive environments and wait for the results. And it certainly does not mean that there is no need for teachers. These, too, are bad theories of learning. They are the progressive, though equally limited, counterpoints to the traditionalists' skill-and-drill approach to learning. (Gee 2005, 5)

The question arises, then: What if a game could have relevance to ordinary life? How can one build a game that both engages students in relevant learning and entertains enough that gamers want to play outside of school? Such a game would combine sound pedagogy with superior entertainment value, seamlessly integrating learning into the world of the game.

Real learning does happen in games, and the learning engaged by gamers shares many attributes with the pedagogy of problem-based learning. Players must solve problems to progress through the game; they can only solve a given problem by accumulating the necessary tools and experience in lower levels of the game. As Warren Spector has said, “Give players tools and information enough to make and execute a plan in response to problems you set up. In the end, that's what gaming is all about“ (Saltzman 2000, 64). That is also, to some extent, what problem-based learning is about: giving students the tools and information to solve a given problem.

Successful learning games, then, will invoke a purposeful pedagogy akin to problem-based learning; the structure and narrative of the game provide the purpose for learning, meaningful problems to solve, and an immediate motivation for pursuing the knowledge required. The problem may be embedded in a game, but the education is no less real.

Constituent Elements of the Killer Application

Games engage players on three main fronts:

- The structure of the game provides motivation and the urge to solve problems for the problem's sake alone.
- The backstory or narrative provides the believability or authenticity of engagement.
- Characterization makes the player's role in the narrative believable so that the player can engage fully in the game.

Not surprisingly, these are also the elements around which learning situations can be constructed. The learning game that works both as a game and as education will use these elements to encourage engagement and support pedagogical objectives. In particular, the design of such an application would translate these elements into the following key features.

The Game Should Use Authentic Content in a Believable Setting

Gee's (2005) discussion of authentic professionalism asserts that a good video game inducts the player into a professional domain made up of "facts, skills, and values in the service of performing a specific identity" ("Conclusion," ¶5). Likewise Owen, Daimant, and Joiner (2007) note:

The original conception of Racing Academy was that through the game play and collaboration with other game players there would be an opportunity to act as a community of scientists and engineers, and use the language and practices of scientists and engineers. It was as much about developing identity as scientist or engineer as learning science or engineering. (9)

Taking this point to its conclusion would mean real-time simulations that place players in identities and social situations as practice for a real-world professional domain, a sort of virtual apprenticeship that supplies the skills and knowledge required for a particular vocation.

For a game, however, believability is more important than authenticity*:* “The purpose of a video game is not to simulate real life, but to offer the gift of playing a game” (Poole 2000, 214). Building verisimilitude is key. While real content is a good thing, it should not disrupt gameplay; the content presentation must be believable within the context of the game. If a believable backstory and mission have been established, real content can be inserted seamlessly into the environment. It's the crucial balance between real content and narrative that works, and the gameplay should drive this. The *DoomEd* half-life mod, for example, integrates real science problems that explore electricity, radiation, acids, and the composition of air into a first-person shooter game (Figure 1). Verisimilitude is only a problem if players don't believe that the character whose role they play is a hybrid of a 007-trained killer and a pretty smart scientist. The combination is not likely, but in the context of the game, it is believable.

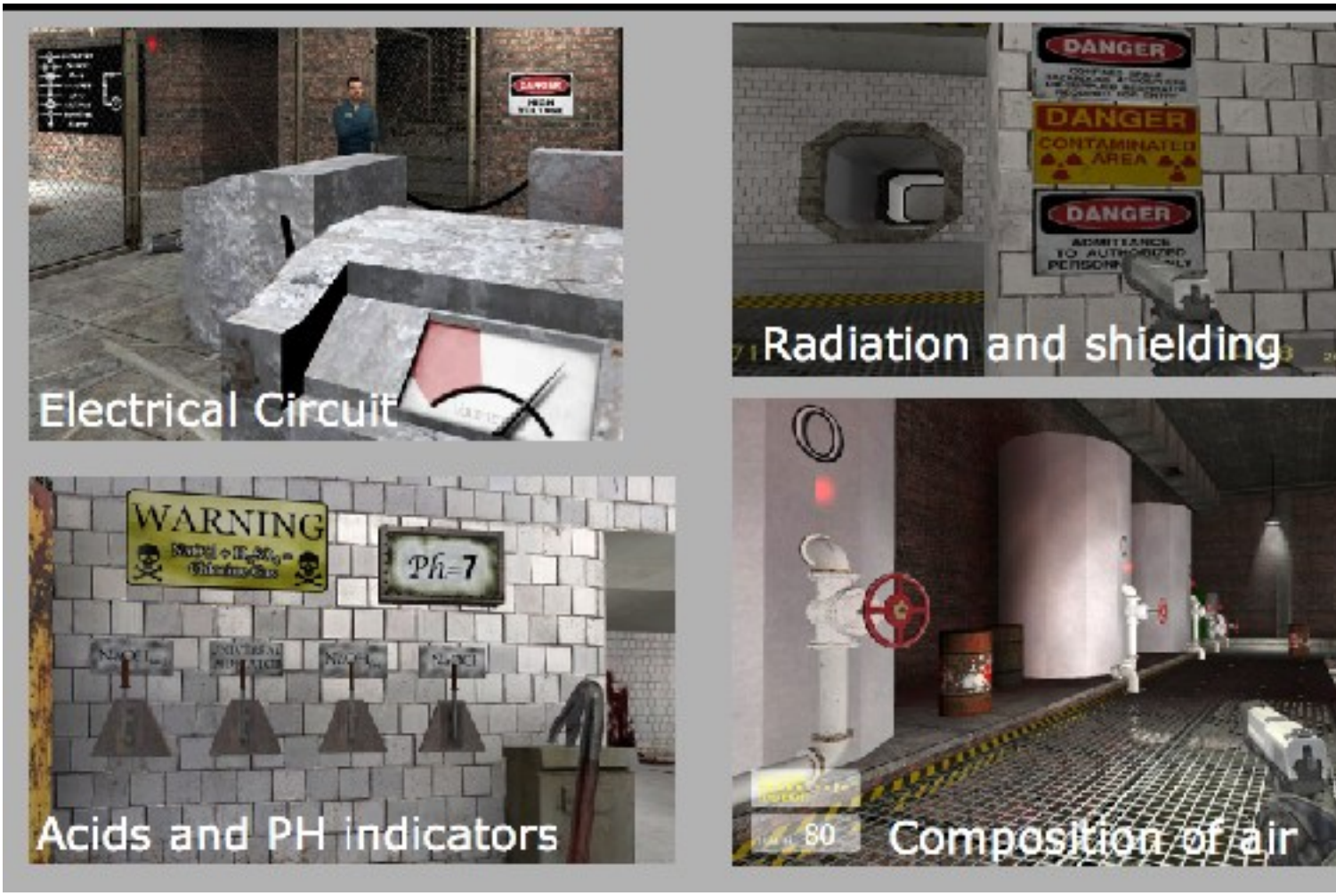

Figure 1. Science problems in *DoomEd*

Puzzles or Obstacles and their Cheats Should Be Linked to Authentic Content

The puzzle is both the challenge that engages players and the hook upon which various kinds of learning can be integrated. Conversation puzzles can require translations, use other languages, present syntax tasks or grammatical queries, or teach standard as opposed to slang forms. Combination inventory puzzles can introduce chemical compounds or genetic fingerprinting and DNA functions. Environment puzzles can offer tasks regarding neutralizing acids, restoring electrical circuits, or maintaining breathable atmospheres. Puzzles and problems need to emerge logically from the narrative structure of the game, and they must be challenging enough to lead users to seek out new knowledge and assimilate it into their existing schema through discovery, trial and error strategies, and seeking knowledge from others.

This last strategy may invoke Vygotskyan social constructivist pedagogy, as well as problem-based learning. Gamers access user communities, cheat sites, and walkthroughs to find the knowledge they need to solve problems that they cannot solve by themselves. In online gaming, the support can be in real time, while play is in progress, and expertise can reside with any player regardless of experience, knowledge, or status outside of the game; a computer science professor may seek the advice of a teenager. Players who are stumped can appeal to the wider playing community, as this *DoomEd* player did:

First puzzle is pretty rough. Can't figure how to turn on the power to open the rear bay door. Can get it to flash on, but not stay on . . . . (Senator33, Post to mod site, November 12, 2006)

This is where learning occurs beyond an individual's own problem-solving capability, through dialogue with peers, teachers, or experts. This is Vygotsky's (1978) zone of proximal development, "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (86).

Different Ways of Presenting Information Should Be Used to Maximize Literacy

Gaming offers a terrific opportunity to develop literacy skills. Because establishing links between the spoken and written word develops literacy, game mechanics should offer both audio and text options. This may be legitimized in the context of the narrative by speech within the game or by artifacts that offer text-based solutions or needed information. In *DoomEd*, for example, solutions are stuck to walls as part of the backdrop, as old posters or scientist's scribblings on chalkboards (Figure 2); *Need for Speed: Most Wanted* uses a text and mobile phone metaphor.

Figure 2. Use of text in *DoomEd*

"Cheating" Should Be Both Intrinsic and Extrinsic to the Game

"Cheats," extra information embedded in the game or available from Web sites, books, and other players, are an established part of the gaming community. They can also be a useful part of a learning game. Within the game, cheats may take the form of clues embedded in artifacts, spoken or written texts, or other characters who give extra information or mediate progress through the game. External cheats require users to read complex instructional text in order to solve a problem, promoting literacy. The search for cheats is itself pedagogically important; the moment a player searches for extra knowledge, an independent learning strategy is invoked.

Each problem or decision point should come with further knowledge offered within a just-in-time framework, thus mirroring the world of project-based work. Game designers should also build a cheat site that augments both gameplay and learning.

Opportunities to Promote Storytelling Should Be Maximized in the Game Design

Storytelling is a potent learning tool:

Stories are a powerful communication tool because they enable listeners to make connections between what is said and their own experience—this helps create meaning and can trigger people into action. (Bonner, Chartier, and Lapointe 2006, 4)

Storytelling is also a key part of gaming, both in the games themselves, which rely on narrative for their power and in which player decisions shape the story, and in the user communities, chatrooms, and face-to-face gatherings where gamers share their playing experiences and offer advice to each other. These peripheral social activities are as important as the game itself because such performance stories, ideas about strategy, and exchanged knowledge constitute forms of learning in their own right. These experiences therefore should be integrated into gameplay wherever possible. *Halo 3*, for example, allows users to share practice and strategy with others through screenshots and video. This can develop reflective practice, analysis, and evaluation, all essential high-level skills in today's information-based society.

Players Should Be Allowed to Customize their Characters

Guiding players through the principles of character development can be a great learning tool that also adds to gameplay. A design brief for different characters specifying personality traits and attributes such as voice, accent, catchphrase, appearance, motivation habits, and other elements will help build believability, bringing the game to life. Customization features that let players create their own content and even their own characters can be leveraged for educational purposes. This strategy has clear links to literacy development in terms of written description; it is also firmly embedded within the concept of personalization as it is described in Leadbetter (2004), where the users of an educational system are not just the receivers of learning, but active participants and coproducers in the educational system. Structured content creation, in the form of character customization or other kinds of customization, can satisfy both sides of the games-education equation, as it both mirrors the functionality of games and the way players engage with them and supports overarching pedagogical objectives.

Conclusion

A commercial learning game should have both gaming and learning outcomes embedded in the game. Gamers will know they are learning, but the main purpose will be game completion. Such games cannot be shortened or sanitized for educational purposes; they must be challenging, fully engaging, commercial games with real entertainment value. Users, immersed in the process of learning and creating within a believable experience supported by real and user-generated content, will develop skills and knowledge for use in other

arenas. The outcomes of playing the game will be achievement and peer kudos, but the process of playing will have done much more.

Learning experiences provided by games will need to rely on collaboration between educators and game designers and should become more commonplace both within commercial spaces and in education as digital technologies reshape established approaches to curriculum delivery. For this to occur, educators and policy makers need to understand more fully the habits and affordances created for learners by informal uses of technology—and engage with learners' digital contexts in a transformational sense of forging "next practice"—rather than adapting these tools to existing educational systems and practices.

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